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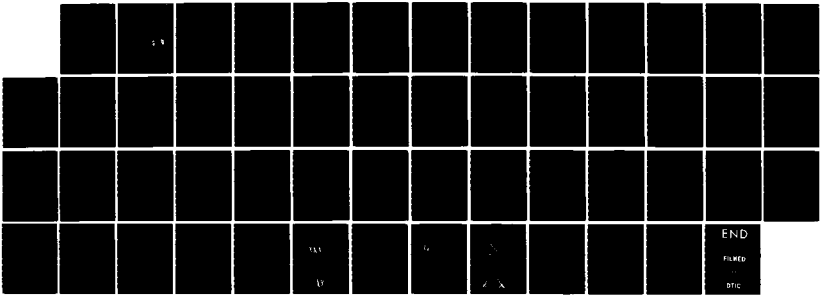

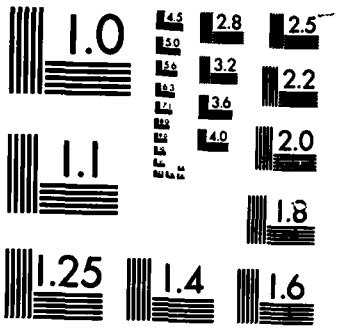

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Procedurally Mediated Social Inferences:

The Case of Category Accessibility Effects

Eliot R. Smith and Nyla R. Branscombe

Purdue University

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Procedurally Mediated Social Inferences: The Case of Category Accessibility Effects

Abstract

Social judgments and social behaviors have been assumed to be mediated by declarative knowledge structures, such as schemas, stereotypes, prototypes, or scripts. In particular, the prevailing theoretical accounts of social priming or category accessibility effects attribute them to changes in declarative memory caused by priming (e.g., the activation of a schema, or changes in the schema's position in a Storage Bin in memory). These prevailing assumptions may be incomplete, and social inferences may be mediated in many cases by content-specific procedures. Based on a review of conceptually related research in cognitive psychology, a model of procedural mediation of category accessibility effects is developed and tested. The experimental results support two hypotheses derived from this model and contradict predictions from the prevailing theories. Priming effects are unrelated to recall and recognition measures of memory for the priming stimuli, and priming a trait construct by presenting behavior descriptions is more effective than direct priming by presenting trait words. Both declarative and procedural mediation of social inferences fit within a general model of memory and inference processes that links social cognition and cognitive psychology.

Procedurally Mediated Social Inferences:
The Case of Category Accessibility Effects

Researchers and theorists in social cognition have taken for granted an interlinked set of fundamental theoretical assumptions. The assumptions rest on a basic distinction between cognitive structures (information represented in memory or perception) and processes (skills, procedures), sometimes referred to as the distinction between declarative and procedural knowledge (e.g., Anderson, 1983). The assumptions are: (1) Social information is primarily represented declaratively--as schemas or other cognitive structures. (2) The information is represented propositionally, in semantically encoded form. Nonsemantic features of information are thought to be "shallowly" encoded and not retained in memory as well as the more "deeply" encoded semantic features (cf. Craik & Lockhart, 1972). (A few theorists assume that visual images may also be used as an alternative form of representation.) (3) The information is represented abstractly rather than as memory traces of specific instances. (4) The declaratively represented social information is used by general, content-free processes to interpret new incoming information, make predictions or inferences, etc. As Allport (1980) notes, these assumptions may derive from an analogy with the von Neumann stored-program computer, in which a content-independent hardware processor works on specific information stored in memory.

Illustrations of the general acceptance of these assumptions are easy to produce. In cognitive psychology, Roediger (1979) and Kolers and Roediger (1984) argue that the assumptions are widely held but should be modified. In social cognition, Wyer and Srull (1980), in their general model of social information processing, assume that declarative knowledge structures (person, behavior, or trait schemas) are drawn from memory and used by general processes (such as an Encoder/Organizer) to guide the processing and storage of social information. Many other theorists hold similar views (e.g., Taylor & Crocker, 1981; Nisbett & Ross, 1980). Definitions of "schema" generally emphasize that it is an "abstract, general structure" (Hastie, 1981, p. 41). Social categories have been assumed to be represented declaratively, perhaps as prototypes, abstract representations of the central tendency of a category (Cantor & Mischel, 1979). Attitudes have been widely assumed to be declaratively represented in long-term memory, perhaps in the form of an associative link between a node representing the attitude object and a node representing a positive or negative evaluation (e.g., Fazio, Chen, McDonel, & Sherman, 1982). All of these common assumptions involve the essentially similar concept of a set of general, content-free cognitive processes that encode, store, retrieve, and use information in ways that are guided by stored content-specific schemas or declarative knowledge structures.

Specifically, these assumptions are part of the prevailing theoretical explanations of social priming or category accessibility effects. Higgins, Rholes, and Jones (1977), Srull and Wyer (1979) and others have demonstrated effects of priming social categories on the

probability of using those categories for interpreting new social information. In the Srull and Wyer study, subjects who study behavioral information related to a category (such as hostility) are more likely to use the primed category to interpret ambiguous behaviors. Srull and Wyer had subjects attend to the priming information under a cover story involving "a test of the way people perceive word relationships". The subjects read a number of word sets such as leg break arm his and had to underline three words that form a complete sentence. In different conditions, either 20% or 80% of the priming word sets were hostility-related as in the example. In an ostensibly unrelated study, subjects then read a paragraph about a character named Donald who performed a number of behaviors (such as withholding the rent from his landlord) that had previously been judged to be ambiguous with respect to hostility. They formed an impression of Donald's personality and rated him on a number of bipolar scales including several related to hostility. The basic finding is that more extensive priming with hostility-related word sets produces ratings that are higher on hostility (Srull & Wyer, 1979).

This effect is long-lasting (enduring over at least 24 hours) and, interestingly, does not depend on any awareness by the subject of the connection between the priming task and the later interpretation task. Srull and Wyer and others successfully deceived subjects into thinking there was no connection, and Bargh and Pietromonaco (1982) demonstrated a similar priming effect under conditions in which, they claimed, subjects were not even aware of the identity of the priming words.

Available theoretical explanations attribute the priming effect to changes in abstract, declarative memory for social concepts or schemas (Wyer & Srull, 1980, 1981; Higgins & King, 1981; Higgins, Bargh, & Lombardi, in press). Wyer and Srull assume that priming places the relevant concept or schema (e.g., hostility) near the top of its linear-ordered Storage Bin in memory. The bin is later searched in top-down order when a schema is sought to interpret the ambiguous behaviors. Priming therefore increases the probability that the hostile schema rather than some alternative will be chosen to interpret the ambiguous behaviors.

Higgins and King (1980) postulate the metaphor of an "energy cell" attached to each schema in memory whose charge is increased by priming but decays or "leaks away" with the passage of time. The amount of charge then affects the probability that this schema will be used later to interpret behaviors. Higgins et al. (in press) generalize the energy cell idea to a family of models involving different assumptions about the production and decay of activation on constructs in declarative memory. They prefer what they call a "synapse model," in which initial activation is binary (all or none) and the rate of decay of activation varies as a function of the frequency of priming.

In this paper we argue that the widespread assumptions regarding the centrality of abstract, declarative memory, and the application of those assumptions to the explanation of category accessibility effects, are incomplete and inadequate. We believe that social information processing is often mediated by procedural rather than declarative knowledge. That is, content-specific procedures are formed and

maintained through experience, and can operate without making reference to declaratively stored, semantically encoded knowledge structures. The paper will first review several types of evidence for this procedural view of information processing, drawn largely from cognitive psychology. The ways in which the evidence fits into a general model of memory and cognitive process (Smith, 1984; cf. Anderson, 1983) will next be discussed. Finally, hypotheses derived from a procedural explanation of category accessibility effects (initially proposed by Smith, 1984, pp. 404-406) will be developed and experimentally tested.

Evidence

When a person encounters some experience, such as observing a conscientious behavior performed by another, the experience may be represented in memory in more than one way. For example, the perceiver may later be able to recall the specific behavioral instance, including details of the context and concrete features of the behavior. In addition, the behavior may give rise to an abstract encoding, such as an inference that the person has the trait of conscientiousness, which might also be stored in memory. Recent research evidence points to yet another type of memory trace that may be left by the experience.

The familiar types of memory test, recognition and recall, are assumed to tap abstract, semantic encodings of an event. Evidence for this assumption includes the superior performance on such tests of subjects who have encoded the study words semantically rather than phonemically or graphemically (Craik & Lockhart, 1972). It is this familiar type of declarative memory of which we are usually consciously

aware when we perform a memory-based task, such as attempting to' retrieve the name of a long-absent acquaintance. These types of memory test are now familiar within social cognition research (cf. Hastie, Parke, & Weber, 1984).

However, recent cognitive research demonstrates that other, less familiar types of memory tests may tap qualitatively different effects of an experience. Several types of test have been studied. Tulving, Schacter, and Stark (1982) use a word-fragment completion (WFC) test, in which several letters are deleted from a word and the subject is asked what word is represented by the remaining fragment (e.g., A__A__IN). Other studies (e.g., Jacoby & Dallas, 1981) use measures of perceptual fluency, such as the ability to read a word that is flashed on a screen for a very short time (usually 35-40 msec). Yet other researchers have used the ability to solve anagrams or the way in which subjects spell homophones as memory tests. These tests have several features in common. They can all be seen as perceptual rather than memory-based tests; that is, subjects are not asked what word from a previously studied list, but simply what word, would complete a word fragment. And all of these tests seem to represent, in various ways, a dimension of perceptual fluency or processing skill.

The simplest description of the results obtained with these novel tests is that studying a word results in improved performance on the tests at a later time--for example, in an increased probability of successfully completing the fragmented word or perceiving the word on the basis of a very brief exposure. Of course, studying a word also results in an increased probability of later recognizing or recalling

the word, but there are differences of great theoretical interest between the perceptual fluency tests and recognition or recall.

Duration of Effects

As mentioned above, a prior exposure to a word facilitates later performance on WFC or perceptual fluency tests. This effect lasts over a period of at least a week (Jacoby, 1983a; Tulving et al., 1982), while recognition or recall performance deteriorates greatly over such a delay. Tulving et al. found, for example, that the level of performance on a WFC test was identical one hour and 7 days after study, while recognition performance dropped from .56 to .24 (hit rate minus false alarms). However, subjects in the Tulving et al. study knew that previously studied words would be included on the WFC test, so they might have been able to use various conscious strategies (self-generation of memory cues) to maintain their performance with the long retention interval. Jacoby (1983a) obtained similar effects over a 24 hour delay when subjects did not know that the two parts of the study were related, making the use of conscious retrieval strategies unlikely. A single exposure to a word seems to produce remarkably long-lasting effects on these perceptual fluency tests.

Independence

Another important point relates to the relationship between performance on the two test types. One possibility is that the different tests tap the same representation in memory, perhaps with different levels of sensitivity. In that case, one would find a strong statistical relationship between recognition and perceptual fluency: the tests would covary. In addition, variables that influence the nature of

the stored representation would affect both types of performance in similar ways. The alternative possibility is that recognition and perceptual fluency tests might tap separate representations in memory, in which case performance on the tests could be largely independent.

Evidence for independence between tests of recognition and perceptual fluency or WFC has been provided in several different contexts recently by cognitive psychologists. Researchers have examined both the ways in which test performance is affected by various independent variables including the passage of time, and the relationship between performance on multiple tests. Tulving, Schacter, and Stark (1982) used both of these techniques. They showed that recognition memory showed a marked decrease between 1-hour and 7-day retention intervals, while WFC performance showed virtually no change. They also showed that (when recognition was tested before WFC performance) the two types of test were statistically independent. Jacoby and Witherspoon (1982) present similar results on the latter issue.

Of course, if a subject can detect increases in perceptual fluency for a particular stimulus, he or she might be able to use that as a basis for responding that the item is "old" in a recognition test. In fact, this seems to be the case. Increased perceptual fluency caused by prior exposure to an item results in a subjective sensation of the item "jumping off the page." Mandler (1980) and Jacoby and Dallas (1981) both argue that people can use this feeling of familiarity, as an alternative to a semantic encoding or elaboration of the item in memory, as a basis for reporting recognition. This fact implies that complete

a course requirement. A total of 104 subjects (52 of each gender) were included, randomly assigned to the four conditions with the constraint that equal numbers of males and females fall into each cell. Subjects were paced through the different "studies" in the booklet at a fixed number of minutes per task. The second task was unrelated to the priming study and was included to allay subject's awareness of the true connections between the priming and dependent measures in the study, as noted above. It also served to introduce a delay of approximately 15 minutes between the priming and the dependent measures and to disrupt short-term memory for the priming materials.

Results

Preliminary analyses examined the main effects and interactions of subject sex. Sex had no significant effects with the intelligent materials. One interaction attained significance for the hostile materials: the interaction of sex x dimension primed. Males showed a slightly greater priming effect than females overall, $F(3,94) = 2.88$, $p < .05$. Since this effect collapses across the two priming methods, it does not qualify the effects of central interest here, and it is not itself interpretable.

Hypothesis 1 called for the priming effect to be independent of recall or recognition memory for the priming materials. This can be examined by a within-cell correlation of the behavior-rating dependent measure with the recall measures. A within-cell correlation is used to avoid spurious influences from the effects of the experimental manipulations. For the hostile priming condition, the priming effect

Following these measures came recall and recognition memory tests which referred back to the first study. Subjects had not been led to expect any memory test up to this point. They were asked first whether they had noticed a general theme or common concept in the word sets or word pairs (i.e., the priming materials), and if so to recall what it was. This was scored for correctness by a lenient general-meaning criterion. On the next page, subjects were presented 12 word sets or word pairs, six of which had appeared in the priming materials and six of which were new, for a recognition memory test. The subjects circled those that they thought had appeared before. The number of correct recognitions and the number of theme-related false alarms (false reports of recognizing items that were related to the primed concept but that were actually new) were scored. A word fragment completion task using conceptually related words was also included for exploratory purposes. Subjects attempted to complete the words intelligent, bright, hostile, and unfriendly (as well as several filler words) on the basis of fragmentary presentation.

The study constituted a 2x2 design, dimension primed (hostile versus intelligent) by method of priming (word sets describing behaviors vs. words directly priming the trait concept). Subjects who received the intelligent priming materials served as the unprimed control group on the hostile dimension, and vice versa. (It is this feature of the design that precludes the use of concepts that are opposites.)

Procedure

Subjects were tested in groups of 16 to 18. They were introductory psychology students, and participation partially fulfilled

Two conceptual domains, hostility and intelligence, were used in this study. The word sets used to prime hostility and the ambiguous behavior description and rating scales used as the hostility dependent measure were drawn from Srull and Wyer's studies.[2] Thirty-two word sets were used, 24 of which were hostility-related (similar to Srull & Wyer's 80% condition). To prime the concept of hostility directly, 32 pairs of words were constructed; examples are unfriendly/hostile and abusive/inconsiderate. Again, 24 of them were hostility-related. This task was introduced (like the behavior priming task) as a study of the way people perceive word relationships, and subjects were instructed to circle those word pairs that had the same meaning. Word sets and word pairs were constructed similarly for the concept of intelligence. Srull and Wyer have used the concept of kindness in their research, but since it is essentially the opposite of hostility our design precluded that choice. Intelligence is conceptually orthogonal to hostility and should serve to test the replicability of the effects in this study.

For dependent measures, all subjects rated the character in Srull and Wyer's "Donald" paragraph on a series of 10-point scales (with endpoints labeled "not at all" to "extremely") including hostile, unfriendly, and dislikable. These three scales were summed to form an index. We wrote a paragraph about "Nancy," who performed ambiguously intelligent behaviors. For example, she went to the library to do some reading, and she found a psychology class pretty easy. Subjects rated Nancy on the same set of scales, of which three (thoughtful, intelligent, and narrow-minded, reverse scored) were summed to form an index for the intelligence-priming replication.

Method

Overview

To test these two hypotheses in two different conceptual domains (considered as replications), a design similar to Srull and Wyer's was used. Subjects were randomly assigned to have one or the other concept primed and were exposed to a priming manipulation similar to Srull and Wyer's (word sets describing behaviors), or to a manipulation intended to prime the trait concept directly (rather than via behaviors). After an intervening task they participated in an ostensibly unrelated experiment, filling out rating scales based on ambiguous behavior descriptions. Finally, they completed measures of recognition and recall for the priming materials. The comparisons of interest are the relative effectiveness of the behavior priming versus direct priming of the concept, and the dependence or independence between recognition/recall and the magnitude of the priming effect.

Materials

All materials were contained in a booklet which purported to represent three entirely unrelated studies. The priming task (presented as a test of how people perceive word relationships) was first, a truly unrelated study of political beliefs, attitudes, and behaviors was second, and the category accessibility dependent measures (presented as a study of person perception) were third. Pilot subjects were specifically questioned and failed to notice the true relationship between the first and third studies, and no subject in the actual test volunteered any awareness of such a relationship.

This analogy between cognitive studies of perceptual fluency and the category accessibility effects studied in social cognition leads to two hypotheses.

(1) The effect of priming a social category (such as hostility) on later ratings of ambiguous behaviors should be independent of conscious recognition or recall of the priming materials. Higgins et al., (in press) recently obtained such a result, for a measure of recall of the priming materials. This hypothesis follows from the theoretical assumption that priming effects are mediated by a procedural memory system, separate from the declarative memory that mediates conscious judgments of recognition or recall. Under a theory that emphasizes declarative mediation of priming effects, recognition or recall and priming are mediated by the same memory system, so one would predict dependence rather than independence.[1]

(2) The effect of priming should be greatest when the priming materials strengthen the <u>same procedures</u> that the ratings require: in this case, procedures for classifying behaviors into the relevant category. This implies that priming by the method of Srull and Wyer (1979), presenting behavior descriptions under a cover story, should be more effective than the presentation of trait terms that directly activate the trait concept (such as hostile). Under a theory that accounts for category accessibility effects in terms of activation of trait concepts in declarative memory, direct priming of the concept should be <u>more</u> effective than priming by the presentation of behaviors, for the latter is more indirect.

particular features as conscientious) will be strengthened by being used, potentially increasing for some time the probability of classifying ambiguous behaviors as conscientious--even those performed by another person in another situation.

Since reports of conscious recognition seem to depend mainly on abstractly encoded declarative memory representations (with the exception that recognition can also be mediated by subjective perceptual fluency), the procedural explanation for priming effects accounts for the fact that they can occur independently of the subject's conscious awareness. The procedural account thus fits well with what is known of social priming effects, in being long-lasting, independent of conscious awareness of the relationship between priming and test performance, and in increasing the "fluency" or probability of recognition of the studied category.

The similarity between the Srull and Wyer priming paradigm and studies of priming effects on word-fragment completion is shown schematically in Table 1. The two types of studies are analogous at the conceptual level, though the actual tasks are quite different, reflecting the difference between procedures for recognizing words based on visual cues (studied in the WFC research) and procedures for recognizing social categories such as hostility based on conceptual cues (attributes of behavior).

Table 1 about here.

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not based, in this viewpoint, on a match between features of the behavior and an abstract "trait schema" (Wyer & Srull, 1980). Instead, we propose that classification into common social categories is procedurally mediated. Within the framework of Smith's model (1984), classification is done by one or more productions whose conditions match relevant features of the stimulus (but which can match even without all the features being present in the input) and whose actions constitute the classification decision. For example, a production would search for certain features of behaviors and, when they are present and the pattern matched, would operate to produce a memory representation signifying that the behavior is representative of a certain trait.

Priming (i.e., practice) strengthens these procedures. The Srull and Wyer priming word sets form hostility-related behaviors, and the subject is assumed to make that conceptual categorization repeatedly as he or she processes the meaning of the sentences. The strengthening effectively decreases the amount of evidence needed to instantiate and invoke the production--as shown by the effects of priming on visual recognition of word fragments or briefly exposed words. In the case of the recognition of conceptual categories, this procedural strengthening has the effect of widening the boundaries of the category, exactly what Srull and Wyer (1979) and others have found. Thus, witnessing a person, John, perform a conscientious behavior may produce not only a declarative memory representation of the event itself and perhaps a declarative encoding of an inference that John is conscientious, but also may affect the perceiver's procedures. The procedures used in processing the behavior (including one that classifies behaviors with

the goodness and extent of its pattern match times the production's strength (Anderson, 1983, ch. 4), strengthening a production effectively reduces the extent of pattern match that is required to invoke it. Thus, a production that has recently been used to recognize a word upon visual presentation will be strengthened and will later be better able to recognize the word upon the basis of a partial pattern match--i.e., when it is presented in word-fragment form, or for a brief exposure time. Production strengthening is completely separate from the formation of a declarative memory trace (for example, a link representing the occurrence of a particular word on a particular study list), and hence perceptual fluency, mediated by production strengthening, should be independent of declarative memory. Anderson's model of procedural strengthening thus predicts the properties of the priming effects reviewed above.

Category Accessibility Effects: Hypotheses

As described earlier, current explanations for category accessibility effects (Higgins et al., in press; Wyer & Srull, 1980) postulate that they are mediated in declarative memory. A procedural view would describe them instead as dependent on the strengthening of procedures. This section outlines the details of this theoretical explanation and derives testable hypotheses from it. The relevant procedures are not those for visual recognition of a word (such as are involved in the WFC and perceptual fluency tests) but for <u>recognition of a conceptual category</u>. Recognition of an object as a member of a category (e.g., the classification of a behavior as conscientious) is

Theoretical Interpretation

What type of representation will preserve a record of a prior processing episode in such a way as to facilitate the repetition of the same processing later? Recent investigations of cognitive skills (e.g., Anderson, 1982) have led to the development of a general cognitive theory, ACT*, incorporating both declarative and procedural knowledge (Anderson, 1983), which has been extended to social cognition (Smith, 1984). In ACT*, procedural knowledge is represented as productions: condition-action (or if-then) pairs that are selected for execution by a pattern match when their condition matches the current state of working memory or the perceptual environment. When executed, the action part of the production can generate new memory structures, execute behavior, or generally perform cognitive tasks. Allport's (1980) review of the literature leads him to conclude, with Anderson, that productions are the most appropriate theoretical vehicle in which to capture the content-specific nature of cognitive processes.

Within this framework, <u>strengthening of procedures (represented as productions) through practice</u> is a form of representation that has the properties described above. Tulving et al. (1982) initially hinted that a procedural memory system might be responsible for the long-term WFC priming effects they studied, without making the claim explicit. Anderson's theory includes the assumption that procedures are strengthened through use (Anderson, 1983, ch. 6), increasing their probability of matching and executing in the future. Since the probability of a production being used is a multiplicative function of

fluency), the study tasks must differ not only in how much is remembered but in what is remembered. And only the type of processing (reading the word from visual cues) that matches the type required on the perceptual fluency test has an impact on that test type later. Carrying out a different type of processing (generation) on the same word has little effect.

These results provide another item of evidence against interpretations of perceptual fluency effects in terms of abstract semantic memory representations of individual words, because any exposure to the word would theoretically lower the threshold (or raise the activation) of such a representation. Instead, some forms of processing and not others influence perceptual fluency, even though the same word is being processed. The memory system that mediates this performance must preserve a record of the <u>type of processing</u> that was carried out, not just the physical stimulus or the identity of the word.

<u>Summary</u>

The overall conclusion of the evidence reviewed here is that abstract, semantic representations of information constitute one basis for memory performance, and are often important for recognition and recall. However, there are other types of memory which may be better tapped by novel test types (such as WFC or perceptual fluency). The evidence suggests that an experience may give rise to multiple representations in memory, and that the representations that are tapped by tests of perceptual fluency are (a) memories for specific processing episodes, (b) long-lasting, (c) largely independent of abstract, semantic encodings in memory, and (d) not dependent on consciousness.

These three points of evidence (together with a fourth to be discussed immediately below) suggest that memory for specific episodes, rather than changes in an abstract, context-free semantic memory representation, underlies the effects of prior exposure to a word on perceptual fluency tests. Consistent with this view, manipulations that affect the availability of memory for episodes, such as retention interval or frequency of study, do have the predicted effects on perceptual fluency (Jacoby, 1983a).

Specific to Type of Processing

Effects of prior experience on perceptual fluency measures are not only specific to the characteristics of the stimulus (e.g., its modality of presentation or physical appearance), but also to the type of processing the subject carries out. The effects therefore seem to be based on memory for a prior processing episode, rather than a past stimulus situation per se (Jacoby, 1983a, 1983b). This claim is based on several studies by Jacoby (1983b). He had subjects in different conditions read a word presented without context (e.g., HOT), read it in a semantic context (e.g., COLD-HOT), or generate the word from a conceptual cue (such as its antonym: COLD-- ?). As is well known, generation produces better recognition memory performance than reading in context, which in turn is superior to reading without context. However, the order of the conditions was reversed for tests of perceptual fluency. Reading without context was best and generation worst for increasing later perceptual fluency. Because the different types of processing (i.e., different study tasks) produced different orders of performance on the two tests (recognition and perceptual

a nonword letter string, for which there can be no pre-existing representation in semantic memory (Jacoby & Witherspoon, 1982). To argue that perceptual fluency effects are mediated by changes in semantic memory, one would have to postulate that a single exposure produces a semantic memory trace, which makes nonsense of the theoretical distinction between semantic and episodic memory.

Second, a single exposure to a word creates changes in perceptual fluency that override the effects of the word's frequency in the language for as long as a day (Jacoby & Dallas, 1981). In general, the semantic memory traces for words (logogens) are thought to have their thresholds tuned to the words' long-term frequencies; this theoretically accounts for the fact that more frequent words are easier to recognize with degraded exposures. The effects of a single exposure on perceptual fluency are too long-lasting to be mediated by this same system of semantic representations (*cf.* Jacoby, 1983a, p. 22).

Third, performance on perceptual fluency tests is relatively specific to such variables as the modality (written or auditory) in which the word was studied and to the typeface of a written presentation (Jacoby & Dallas, 1981; Jacoby & Witherspoon, 1982). That is, perceptual fluency is increased much more when the study presentation matches the test presentation in modality and typeface. An abstract logogen or schema representing a word or concept in semantic memory does not, by definition, contain such specific details as the typeface in which a word appeared on a particular occasion, so it cannot mediate such specific effects.

Based on Specific Episodes

One possible view about the difference between recognition and perceptual fluency tests is that they tap two different declarative memory systems: episodic and semantic memory (Tulving, 1984; Tulving, 1972). Recognition must rest on episodic memory, which is indexed by a specific time, place, or context. Recognition tests do not ask whether one has ever seen this word before, but whether the word occurred in a particular study list. Perceptual fluency, on the other hand, might be claimed to rest on a long-lasting increase in activation (or lowering of the threshold) of an abstract representation of a particular word in semantic memory--similar to the prevailing explanations of category accessibility effects in social cognition (Wyer & Srull, 1980; Higgins et al., in press). The increased activation might account for the improved ability to recognize the word based on fragmentary perceptual evidence. An assumption of dual episodic and semantic memory systems might then be invoked to explain the independence of perceptual fluency and recognition performance.

However, perceptual fluency effects are probably not interpretable in terms of increases in the activation or accessibility of an abstract construct in declarative memory. Instead, the evidence suggests that they are mediated by memories for specific episodes. Jacoby and Dallas (1981), Jacoby and Witherspoon (1982), and Jacoby (1983a) present the most complete evidence that such tests reflect memories for a specific episode, rather than the degree of activation of an abstractly encoded representation of a word in memory. First, increases in perceptual fluency can be produced by a single exposure of

independence of recognition and other types of memory test will not always be observed, since recognition may at times be based on subjective perceptual fluency. In fact, experiments show that if nonwords are tested for recognition, recognition and perceptual fluency tests are highly correlated. The theory predicts this, since with nonwords, the subject cannot rely on a semantic encoding and recognition must be completely based on perceptions of fluency (Jacoby & Witherspoon, 1982). What one should expect in general is not independence of recognition and perceptual fluency <u>performance</u> (since the latter may sometimes be used as one basis for recognition), but independence between the two types of <u>memory representation</u>: abstractly encoded meaning and whatever representation underlies perceptual fluency.

Perhaps the most intriguing property of performance on perceptual fluency memory tests is that it depends on the subject's conscious processing of the studied information to a much lesser extent than does recognition memory--if at all. Prior exposure to a word in a study list facilitates later performance on WFC or similar tests by an equal amount regardless of whether the person can consciously remember having studied the word; this is just a restatement of the independence of the two test types. In addition, the subject may not be aware that test performance is influenced by any prior experience; the WFC and perceptual fluency tests are presented as perceptual rather than memory-based tasks. For these reasons, Jacoby and Witherspoon (1982) label the novel types of test as measures of "remembering without awareness."

was uncorrelated with any memory measures; see Table 2. None of these coefficients even approach significance. For the intelligent priming condition, the correlations with recall and correct recognition of the priming materials are nonsignificant. On the other hand, the correlation with the false-alarm recognition measure is significant. People who show a larger priming effect also tend to falsely report recognizing more theme-consistent distractor items in the recognition test. In fact, such false recognitions could be viewed as a type of category accessibility effect. Bargh and Pietromonaco (1982, p. 446) made a similar argument when they found that priming increased false recognition of theme-related distractor items.

The data clearly support the first hypothesis. In one replication there is effectively a zero relationship between priming and memory tests, and in the other the correlations with recall and correct recognition are near zero, and only the correlation with false-alarm recognitions is significant. As noted above, Higgins et al. (in press) similarly found that priming effects were independent of a measure of recall. The prediction from the alternative theoretical viewpoint, that of declarative mediation of priming effects, would be for substantial positive correlations between priming and memory measures, and this pattern is clearly not found.

The word fragment completion results (the number of the theme-related fragmented words completed by the subject, ranging from 0 to 2) were also analyzed and correlated with the priming effect. The correlations were nonsignificant for both replications, as Table 2 shows. The memory trace responsible for the conceptual priming effect

does not cause increased recognition of concept-related words from visual cues.

Table 2 about here.

The second hypothesis called for the effect of priming by the Srull and Wyer method (behavior descriptions) to be greater than the effect of priming trait terms directly. This hypothesis is tested by a planned comparison of the behavior priming cell against the word priming cell. For hostility, this comparison is significant, $t(100) = 2.35$, $p < .01$. Table 3 shows the means.[3] For the intelligent priming condition, this comparison is in the predicted direction but does not attain significance; $t(100) < 1$. However, comparisons examining the effect of each priming method separately against the unprimed group show that the behaviors do produce a significant priming effect, $t(100) = 2.41$, $p < .01$, while the direct priming of words has no significant effect, $t(100) = 1.42$, $p > .10$. Priming behaviors is, as predicted, more effective than direct priming of the trait words.

Table 3 about here.

The superiority of priming behaviors to direct priming of trait-related words is not simply an artifact of differential overall strength of the two manipulations. As Table 3 shows, word priming produced higher scores on several memory dependent measures: recall of the intelligence theme ($t(100) = 3.04$, $p < .001$), hostile word-fragment

completion ($t(100) = 2.71$, $p < .01$), and hostility-related false recognitions ($t(100) = 6.08$, $p < .001$). Several other measures showed no significant differences between the two priming manipulations: intelligent word-fragment completions and hostile theme recall and correct recognitions. These results show that the two types of manipulations are both effective, but cause different types of memory traces which show up in different types of performance (e.g., recall versus ratings of ambiguous behaviors). This demonstration is conceptually parallel to that provided by Jacoby (1983b), who showed that generating as compared to reading words produced better recognition memory but worse word-fragment completion performance. Besides showing that the word-priming manipulations are not simply too weak to have any effects at all, this provides another type of evidence for the independence of the two types of measures (recognition and recall memory versus category accessibility).

Discussion

The view that category accessibility effects are procedurally mediated fits the data better than the alternative view stressing declarative mediation, for both hypotheses in both replications. The declarative model would predict covariation between tests of recall or recognition and category accessibility effects, and would also predict that directly priming the trait concept should produce larger effects than indirectly priming it via behaviors. Both of these predictions were contradicted by the data, while hypotheses based on the notion of procedural mediation were supported. Category accessibility effects are

equally strong for subjects who do not consciously recall or correctly recognize the priming materials as for those who do. Priming trait concepts by presenting related behaviors is more effective than "direct" priming by presenting trait words.

These results strengthen our overall model of procedural mediation, which involves several novel assumptions. Classification of stimuli into social categories (e.g., classifying behaviors as hostile or intelligent) is done at least in part by procedures, rather than by matching the stimuli against the features of a declarative knowledge structure (schema or prototype). Procedures in Anderson's model (1983) are represented as productions. The condition part includes a pattern matching features of the behavior, and the action part represents the classification decision, creating a memory structure encoding the inference "this act is hostile." Like any cognitive skills, categorization procedures can be strengthened by practice. Shiffrin and Dumais (1982, p. 127) suggest that both the number of successful applications of a procedure (e.g., the number of behaviors classified as hostile during the priming) and the proportion of trials on which the application is successful (e.g., the ratio of hostile to nonhostile behaviors studied) influence the strength attained by a procedure. Effects of varying these variables were not investigated in this study, which held constant both the number and ratio of priming trials. However, Srull and Wyer (1979) manipulated these variables and found that both the number and proportion of hostile priming trials influenced the magnitude of the priming effect, in accord with this prediction (and contrary to the prediction of the unmodified Storage Bin model, which

predicts a pure recency effect and no effects of frequency or proportion).

The stronger a procedure, the more successful it will be at matching and applying with an incomplete or ambiguous data pattern (pattern match; Anderson, 1983, ch. 4). Thus, practice effects show up as increased category accessibility when the procedures being practiced are those for categorization of stimuli. Of course, practicing other types of procedure (such as those for visually recognizing words) will produce other types of observable effects (such as increased perceptual fluency). Such practice effects seem to be quite long-lasting; Tulving et al. (1982) demonstrated effects on word-fragment completion 7 days after study, and Srull and Wyer showed category accessibility effects after a 24 hour delay.

Higgins et al. (in press) recently investigated the decay of priming effects produced by frequent and recent priming. They point out that the Storage Bin model predicts pure recency effects, and that several other models may be discriminable by their differential predictions of decay rates. In their study, they primed opposite concepts such that concept A was primed more frequently than its opposite B, while B was primed most recently. The results showed that the recently primed concept had more strength immediately after priming, while the more frequently primed concept was stronger later on. The assumptions regarding the accumulation and decay of production strength in Anderson (1983, pp. 174, 251) can predict this pattern. In fact, those assumptions (a fixed, unit increment of strength per activation, additive effects of multiple activations, and a power-law decay curve)

represent quantitatively the patterns of activation and decay that Higgins et al. (in press) assume in their preferred "synapse model."

Some types of priming effects may not be procedurally mediated. Neely (1977) and others have investigated the effect of priming a word on the time to recognize a semantically related word when both are presented visually. These effects seem to be mediated by two different processes, depending on the experimental conditions: (1) automatic spreading activation in declarative memory, which primes semantically related words in a fast-acting and automatic manner, and (2) conscious expectations by the subject of a particular category of word, which develop more slowly but can be longer-lasting. The effects of automatic spreading activation seem to last for a few seconds at most, but the effects of conscious expectations can be extended in time by active rehearsal of the concept, or reinstated later by a memory cue that reminds the subject of the primed concept (Foss, 1982). That is, these expectations are under conscious strategic control of the subject. Priming effects that are mediated in declarative memory may be responsible for the category accessibility effects obtained by Higgins et al. (1977) and others by priming trait concepts directly. However, the exact mechanisms by which direct priming of a trait concept produces later effects are not clear because the duration of the effect seems to be longer than can be explained without the mediation of conscious expectations, which should be diminished by the presentation of the priming and rating as "two unrelated studies."

The findings of this study and the related research reviewed in the first part of this paper have important theoretical implications. They point to the need for a general cognitive model which encompasses both procedural and declarative memory systems, as does the model of Anderson (1983). These dual systems--an abstract, consciously accessible propositional declarative memory and a more concrete, content-specific, automatically applicable procedural memory--work in concert to account for performance on social and nonsocial tasks. One significant theoretical possibility is that procedural memory may be more responsible for generating affect and behavior (at least in routine, familiar situations), while declarative memory is more important for abstract thought and decisions in novel situations. Studies of the interrelations of declarative and procedural memory systems may therefore help clarify relationships among cognition, affect, and behavior.

The procedural view of social inference has practical as well as theoretical implications. For instance, attempts to change attitudes have often centered on the general strategy of providing the person with new information (e.g., in persuasive communications). The procedural view leads to the insight that such a strategy may change only the contents of declarative memory, without changing the person's procedures. The behaviors used in interacting with the attitude object, and the feelings (positive or negative) elicited by the object, may be mediated more by procedures than by the changed declarative knowledge (cf. Fazio et al., 1982). To change affect or behavior, extensive practice may be needed to create and strengthen new procedures to the

point where they exceed the old ones in strength and can out-compete them. Alternatively, the person may have to consciously plan new behavior on every relevant occasion, relying on declarative knowledge and controlled processing rather than automatically accessible procedures (similar to the planned as opposed to scripted behavior of Schank & Abelson, 1977). Those who have attempted to stop smoking or change their eating or exercise habits know how difficult it is to maintain intentionality at every point in the daily routine where old procedures are highly practiced and accessible.

Another recent piece of evidence that implicates procedures as mediators of a well-known effect is that of Seamon, Brody, and Kauff (1983). They argue that the effect of mere exposure on increasing liking, and the fact that it is independent of conscious memory for the prior exposure (Zajonc, 1980), are attributable to procedural mediation. Exposure to the stimulus strengthens procedures for visually recognizing it, and this strengthening is (as demonstrated by studies cited above) independent of conscious recognition memory. Seamon et al. argue that when the stimuli are initially affectively neutral, the increased feeling of familiarity (perceptual fluency) caused by prior exposure is interpreted by subjects as a feeling of liking. Thus exposure increases liking for neutral stimuli, in a manner that is mediated by procedural strengthening and independent of conscious recognition.

The procedural view, and models of social inference and memory that incorporate procedural as well as declarative knowledge (such as Smith, 1984), may help account for phenomena that have been recognized as theoretically significant but puzzling. These include the effects of

priming on category accessibility, the difficulty of changing attitudes by providing new information, and the effects of mere exposure on liking and their independence of conscious awareness of the prior exposure. The rejection of the view that abstract, declarative knowledge structures such as schemas or scripts account for all interesting social judgments and behaviors, and an acknowledgement of the significance of procedural knowledge, is a first step toward such major theoretical gains.

Footnotes

1. Some (for example, Higgins et al., in press) explain this independence in terms of separate semantic and episodic memory systems within declarative memory. Evidence against this position was cited earlier.

2. We are indebted to Thomas Srull for making available these stimulus materials.

3. Note that in the hostile replication the unprimed condition has a higher mean than the word-priming condition, though the unprimed control group would be expected to be the lowest. However, in the design these subjects received the intelligent priming materials, and it is possible that these materials are not <u>exactly</u> orthogonal to hostility. Priming intelligence may have activated the concept of kindness (non-hostility) to some limited extent. In any case, the comparison of the two cells with different priming methods is the test of the hypothesis of interest here.

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Table 1

Comparison between Word-Fragment Completion Priming and Category Accessibility Studies

	WFC Priming	Category Accessibility
Priming		
Stimuli	Written words	*Descriptions of hostile* behaviors
Responses	Identify words	Classify behaviors as hostile
Procedures used and strengthened	Recognition of words based on visual features	Recognition of trait based on behavioral features
Delay		
Delay length	At least 24 hours	At least 24 hours
Subject awareness of connection between priming and test	Not necessary	Not necessary
Test		
Stimuli	Fragmented words	Ambiguously hostile behaviors
Effect of priming	Facilitates identification of words	Facilitates classification of behaviors as hostile

Table 2

Within-Cell Correlations of Ratings of Ambiguous Behaviors with Other Memory Measures

Memory Measure	Hostile Priming	Intelligent Priming
Recall of Theme	-.025	-.047
Correct Recognitions	.015	-.141
Theme-Related False Recognitions	-.027	.263*
Word-Fragment Completions	.038	-.157

Note: df = 96. *$p < .05$

Table 3

Effects of Priming Conditions on

Ratings of Ambiguous Behaviors and Memory Measures

Hostile Priming

Measure	Behaviors	Words	Unprimed
Ratings of Ambiguous			
Behaviors	8.28	7.04	7.86
Recall of Theme	.50	.35	--
Correct Recognitions	5.31	5.19	--
Theme-Related False			
Recognitions	.08	.88	--
Word-Fragment Completions	0.85	1.35	1.08

Intelligent Priming

Measures	Behaviors	Words	Unprimed
Ratings of Ambiguous			
Behaviors	3.18	2.87	2.42
Recall of Theme	.08	.31	--
Correct Recognitions	5.35	4.88	--
Theme-Related False			
Recognitions	.96	.42	--
Word-Fragment Completions	1.04	1.04	0.67

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Mr. Luigi Petrullo
2431 North Edgewood Street
Arlington, VA 22207

Sequential by Principal Investigator

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Yale University
School of Organization and Management
New Haven, Connecticut 06520

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University of Hawaii
2430 Campus Road
Honolulu, HI 96822

Dr. Jomills Braddock
John Hopkins University
Center for the Social Organization
of Schools
3505 N. Charles Street
Baltimore, MD 21218

Dr. Sara Yogev
Northwestern University
Graduate School of Management
2001 Sheridan Road
Evanston, IL 60201

Dr. Terry Connolly
University of Arizona
Department of Psychology, Rm. 312
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Department of Management
College Station, TX 77843

Dr. Randy Dunham
University of Wisconsin
Graduate School of Business
Madison, WI 53706

List 13 (continued)

Dr. J. Richard Hackman
School of Organization
and Management
Box 1A, Yale University
New Haven, CT 06520

Dr. Wayne Holder
American Humane Association
P.O. Box 1266
Denver, CO 80201

Dr. Daniel Ilgen
Department of Psychology
Michigan State University
East Lansing, MI 48824

Dr. David Johnson
Professor, Educational Psychology
178 Pillsbury Drive, S.E.
University of Minnesota
Minneapolis, MN 55455

Dr. Dan Landis
The University of Mississippi
College of Liberal Arts
University, MS 38677

Dr. Frank J. Landy
The Pennsylvania State University
Department of Psychology
417 Bruce V. Moore Building
University Park, PA 16802

Dr. Bibb Latane
The University of North Carolina
at Chapel Hill
Manning Hall 026A
Chapel Hill, NC 27514

Dr. Cynthia D. Fisher
College of Business Administration
Texas A&M University
College Station, TX 77843

Dr. Thomas M. Ostrom
The Ohio State University
Department of Psychology
116E Stadium
404C West 17th Avenue
Columbus, OH 43210

Dr. William G. Ouchi
University of California,
Los Angeles
Graduate School of Management
Los Angeles, CA 90024

Dr. Robert Rice
State University of New York at Buffalo
Department of Psychology
Buffalo, NY 14226

Dr. Benjamin Schneider
Department of Psychology
University of Maryland
College Park, MD 20742

Dr. H. Wallace Sinaiko
Program Director, Manpower Research
and Advisory Services
Smithsonian Institution
801 N. Pitt Street, Suite 120
Alexandria, VA 22314

Dr. Eliot Smith
Psychology Department
Purdue University
West Lafayette, IN 47907

Dr. Barbara Saboda
Public Applied Systems Division
Westinghouse Electric Corporation
P.O. Box 866
Columbia, MD 21044

Dr. Harry C. Triandis
Department of Psychology
University of Illinois
Champaign, IL 61820

Dr. Anne S. Tsui
Duke University
The Fuqua School of Business
Durham, NC 27706

Dr. Andrew H. Van de Ven
University of Minnesota
Office of Research Administration
1919 University Avenue
St. Paul, MN 55104

Dr. Sabra Woolley
SRA Corporation
901 South Highland Street
Arlington, VA 22204

END

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